

5.2 City of New Braunfels

5.2.1 Flow-Split Management in the Old and New Channel

Presently, the culverts governing flow from Landa Lake into the Old Channel are inoperable. As a result, a constant level of springflow proceeds through the culverts and into the Old Channel. Over time, this has led to the scouring of preferred native vegetation types for fountain darters, and the establishment and eventual dominance by non-native non-preferred aquatic vegetation. Flow-split management is intended to complement the ecological restoration of aquatic vegetation in the Old Channel, by reducing long-duration high flows and allowing for more seasonal variability to be maintained, mimicking a more natural flow pattern.

To minimize and mitigate the impacts of low flows, the City of New Braunfels staff will manipulate at least once monthly the valves and culverts to the Old Channel and New Channel of the Comal River for the protection of existing and restored native aquatic vegetation in the river, based on EAA's real-time flow gauges in these channels and as often as appropriate for the maintenance of a beneficial hydrologic condition of the Old Channel habitat. Prior to this, the City of New Braunfels will replace and repair existing gates and control mechanisms to restore the operability of all four water paths to the Old Channel from Landa Lake: the two small

¹ See also Section 5.5.2.

culverts, the one large culvert, and the Springfed Pool inlet. This repair will allow for the manipulation of water flow per the flow split strategy in Table 5-3 and the prevention of sustained high flows in the Old Channel that resulted in scouring.

A second objective is to maximize the quality of habitat in the Old Channel. This will be accomplished by: (1) providing an appropriate level of flow variability during average to high flow conditions; and (2) allowing proportionally more water to flow through the Old Channel versus the New Channel during periods of critically low-flow with the ultimate goal of preserving high quality fountain darter habitat within the Old Channel as long as possible.

A detailed description of flow-split management is described in BIO-WEST (2011c). Based on the analysis conducted to date, the desired goal for maximizing fountain darter habitat in upper portions of the Old Channel at all times is to maintain 40–80 cfs. Extremely uniform suitable habitat is present in the New Channel under modeled (10–300 cfs) flows (Hardy 2011). Table 5-3 describes the flow-split for total Comal springflow conditions. During average to high flow conditions the focus is on a seasonal flow split in order to optimize habitat conditions in the Old Channel over time. Slightly higher flows during the fall and winter will provide some channel maintenance benefit while not hindering overall fountain darter habitat. Optimal habitat conditions are proposed for spring and summer to provide the best opportunity for fountain darter recruitment.

**TABLE 5-3
FLOW-SPLIT MANAGEMENT FOR OLD AND NEW CHANNELS**

Total Comal Springflow (cfs)	Old Channel (cfs)		New Channel (cfs)	
	Fall, Winter	Spring, Summer	Fall, Winter	Spring, Summer
350+	80	60	270+	290+
300	80	60	220	240
250	80	60	170	190
200	70	60	130	140
150		60		90
100		60		40
80		50		30
70		50		20
60		40		20
50		40		10
40		30		10
30		20		10

When total Comal springflow flows drop to 150 cfs, the flow split will be shifted to protecting the maximum amount of habitat within the Old Channel year-round, while continuing to provide flow in the New Channel at all times (see Table 5-3). Additionally, when total Comal springflow drops below 100 cfs, if necessary, the City of New Braunfels staff will manipulate the valves and culverts more frequently to maintain the flow split ratio as detailed in Table 5-3.

As discussed in Hardy (2011), 20 cfs in the Old Channel will provide approximately 75 percent of the maximum available fountain darter habitat in the Old Channel from a physical habitat perspective. In addition to physical habitat, four checkpoint temperature ranges have been identified as critical to the fountain darter life cycle: at and above 77 to 79°F there is reduction in fountain darter larval production; between 79°F and 82°F and above there is a reduction in egg production, and at approximately 91°F and 94°F larval and adult thermal death can be expected based on laboratory studies (Brandt *et al.* 1993, Bonner *et al.* 1998, McDonald *et al.* 2007). At 20 cfs, under the extreme ambient temperature conditions modeled in Hardy (2011), the Old Channel area between Landa Lake and Golf Course Road [Model Segment 18; Hardy 2011] is projected to maintain water temperature below three of the four temperature threshold ranges at all times. Reduced larval production (up to 63 percent) has the potential to occur for portions of the day based on laboratory results from McDonald *et al.* (2007). Hardy (2011) shows that the lower portion of the next modeled segment downstream (Reach 19 – Old Channel above Elizabeth Street) is projected to have water temperatures high enough during portions of the day to cause reduction in egg production as well. All subsequent downstream Old Channel segments also are projected to have temperatures at least as high for short periods of time. However, it should be reiterated that even at 20 cfs, nowhere in the Old Channel during the extreme conditions modeled, are water temperatures projected to exceed levels necessary for adult or juvenile survival. (Hardy 2011).

Additionally, it should be noted that the City of New Braunfels is in the process of restoring the functionality of the Landa Lake Spillway and Landa Lake Dam. This repair and restoration project will protect the Old Channel from scouring in less severe rainfall events and reduce sedimentation effects in the Old Channel. This repair is contingent upon receiving permits from the Army Corp of Engineers and the USFWS.

5.2.2 Native Aquatic Vegetation Restoration and Maintenance

It has been documented over the past decade (BIO-WEST 2002a–2011a) that native aquatic vegetation plays a key role in supporting the native fish assemblages, including the fountain darter. To minimize and mitigate the impacts of incidental take from low-flow events by providing better habitat conditions for the ecological community, the City of New Braunfels will undertake a program of native aquatic vegetation restoration within key, sustainable reaches of the Comal River by planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal.

The amounts and types of vegetation removed and restored in this program will be established by Table 4-5 and 4-6 respectively. Two-dimensional hydraulic models will be used to evaluate the potential for success of the native vegetation restoration. This evaluation will consider the depth, velocity, and substrate conditions present in the proposed areas along with what non-native vegetation is thriving in these areas. In areas that are bare of vegetation, the reason vegetation is absent (*e.g.*, recent flood scour, or unsuitable depth, velocity or substrate conditions) will be evaluated prior to restoration. Following an evaluation of the physical habitat model, an evaluation of water quality conditions will also be conducted. In particular, the CO₂

need of the native aquatic plant being considered for establishment and the CO₂ concentrations in the water column under varying flow conditions at the proposed restoration locations will be evaluated.

Additionally, restoration will involve acquiring local, disease- and pathogen-free plant material. The material will be removed from adjacent habitat, propagated off-site (e.g., at the NFHTC) using plant material removed from the Comal system. Alternatively, it may be purchased from vendors who meet locality and disease free criteria. When non-native species are removed, they will be disposed of properly.

The focus of native vegetation restoration will be on Landa Lake downstream of Spring Run 3 but above the New Channel USGS weir and on the portions of the Old Channel bordered on both sides by City of New Braunfels' property, including the Old Channel ERPA. Restoration efforts will also include establishing additional *Cabomba* along the eastern shoreline of Landa Lake and along the New Braunfels' golf course property to create valuable fountain darter habitat.

5.2.2.1 Old Channel Environmental Restoration and Protection Area (Old Channel ERPA)

To minimize and mitigate the impacts of recreation and pumping during periods of low flow, the City of New Braunfels will remove problematic non-native vegetation, restore native habitat (per Table 4-6), undertake limited channel modification to enhance fountain darter habitat, and remove a small sediment island. The Old Channel Environmental Restoration and Protection Area (ERPA) includes the EAA Variable Flow Study reach below Elizabeth Street upstream to the culverts feeding the Old Channel from Landa Lake where the preferred native aquatic vegetation of the fountain darter has been scoured and replaced over time with less-preferred non-native aquatic vegetation.

This measure does not include an experimental channel or recirculation in Landa Park. As additional research is conducted and new data established, the City of New Braunfels will consider additional measures to protect habitat in this stretch of the Old Channel, see BIO-WEST (2011c), based on the protocols set forth in the FMA for determination of AMP measures and their implementation.

One specific area of targeted sediment removal is a small island that has formed just behind the Springfed Pool and immediately downstream of Landa Lake. This sediment island continues to grow, has established destructive non-native cane, and has displaced/destroyed fountain darter habitat.

5.2.2.2 Comal River Restoration

Upon final determination of locations suitable fountain darter habitat for restoration in the Comal River proper (below the USGS gauging weir, aka Stinky Falls), the City of New Braunfels will conduct native vegetation restoration and yearly maintenance to establish additional fountain darter habitat. Areas for targeted restoration preferred by the City of New Braunfels include the

portion of the Comal River between Last Tubers Exit and the confluence of the Guadalupe River and portions of the Comal River that allow for protection on one side of the river and safe passage of recreators on the other side of the river. Once the habitat has been established, TPWD will pursue creation of State Scientific Areas to protect fountain darter habitat.

5.2.2.3 Native Aquatic Vegetation Maintenance

Restoring native vegetation within the Comal system will benefit the Covered Species, but will be unsuccessful or likely very limited in success if it is not monitored and protected over time. One-time restoration contradicts the purpose for these activities which is to provide better habitat conditions for the ecological community over time and in particular, upon entering into critical low-flow periods. To sustain these conditions prior to entering into low-flow periods, the City of New Braunfels will conduct yearly maintenance of native aquatic vegetation restoration sites in Landa Lake and the Old Channel, and the flow-split management discussed above in Section 5.2.1.

Native aquatic vegetation maintenance consists of actively monitoring and maintaining planted stands of native vegetation. Temporal monitoring will incorporate some form of quantitative measurement system to assess whether plantings are increasing, decreasing, or remaining stable. Additionally, intensive non-native vegetation control in the adjacent areas will be implemented until the native vegetation is well-established. It will include additional activities following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism. Anytime a disturbance is observed, the monitoring/maintenance schedule will be modified temporarily in order to provide the stability for the native vegetation re-establishment.

5.2.3 Management of Public Recreational Use of Comal Springs and River Ecosystems

To minimize and mitigate the impacts of recreation, the City of New Braunfels will manage recreational use of the Comal Springs and Comal River Ecosystem through two methods:

- 1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce these regulations, including:
 - a. Limiting recreation on Landa Lake to Paddle Boats
 - b. Prohibiting recreational access to the Spring Runs in Landa Park to the Wading Pool in Spring Run 2.
 - c. Prohibiting water recreation on the Old Channel; with the exception of Schlitterbahn operations within its present location.
- 2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section. Outfitters that opt into the COI program and receive a COI will receive incidental take coverage during the term of the COI, which

shall not extend beyond the Permit term. The City of New Braunfels is not required to regulate the recreational activities of those Outfitters that choose not to participate through the COI process beyond the minimization and mitigation activities the City of New Braunfels has committed to undertake in this HCP.

Outfitters can apply for a COI when the ITP is issued and every two years thereafter. For those Outfitters that voluntarily participate in order to obtain incidental take coverage for their recreational activities, the COI will contractually require those Outfitters to comply with and implement listed minimum standards set out below. The City of New Braunfels will not reduce or eliminate any of the listed minimum standards during the 15-year ITP term but reserves the right to add additional standards in the future. COIs from the City of New Braunfels will be issued for a two-year term; so that every two years conditions of the COI may be re-evaluated and increased if necessary to further promote mitigation activities, reflect changes in New Braunfels policy or ordinance as related to protection of habitat or address new information established through the best science available as related to the species. The City will provide each year to the Program Manager for incorporation into the Annual Report a copy of all COIs issued during that year and information regarding the Outfitters compliance with the minimum standards.

Minimum COI Outfitter Standards

- a. Provide litter bags to all customers
- b. Sponsor one Comal River Cleanup annually. Outfitters may sponsor an existing river cleanup or may organize their own. Services and resources provided as a sponsor must exceed \$1,000 in direct payment or in-kind service.
- c. Provide at point of purchase at place of business, educational signage about the endangered species, their Critical Habitat, and efforts to promote the Covered Species (largely HCP initiatives and Critical Period Management information). Design and artwork will be produced and supplied by the City of New Braunfels. Signage must be at a minimum 3'x 6'.
- d. Require all businesses, at their respective business locations, to support and assist the City of New Braunfels' enforcement of laws that relate to the Covered Species and their habitat. Specifically, this applies to, but is not limited to, litter prevention and habitat protection.
- e. Outfitters must submit a yearly report to the City of New Braunfels by January 1 of each year, detailing activities related to the COI for the previous year.
- f. If established, Outfitters shall provide at point of purchase at place of business, a map and educational sign about the State Scientific Areas. Design and artwork will be produced and supplied by the City of New Braunfels. Combined map and sign must be at a minimum 3'x 6'.

- g. Assist the City of New Braunfels with implementation of additional recreational management measures and controls at flows below 100 cfs to reduce habitat effects, water quality degradation, and other determined negative effects.
- h. Stencil all outfitter rented recreational equipment with an anti-litter message. The City of New Braunfels will design and supply the stencil to be used.

If an Outfitter is in violation of any standard, the City of New Braunfels may suspend or revoke the Outfitter's COI after providing notice, an opportunity to come into full compliance, and a hearing.

5.2.4 Decaying Vegetation Removal and Dissolved Oxygen Management

The largest uncertainty noted in the Hardy (2011) report is the potential effect of extended low-flow periods on aquatic vegetation dynamics within the Comal system as neither the hydraulic and habitat modeling, nor water quality modeling conducted addresses this issue. The main concern is that under extremely low-flow conditions, aquatic vegetation may start to die, and subsequently decay, consuming a large amount of dissolved oxygen (DO) during the decay process. This in turn could cause large swings in the DO concentration within Landa Lake, which depending on the severity, could affect the biological community including the fountain darter. The concern is probably limited to the lake portions of the system as the culverts and weirs present at the uppermost portions of the Old and New Channels would likely provide sufficient re-aeration to compensate for most events. However, within the lake environment, problems could occur.

To minimize and mitigate the impact of incidental take from low-flow events, upon receipt of DO data indicating a water quality concern created by decaying vegetation and the total Comal springflow drops below 80 cfs, the City of New Braunfels will implement a dissolved oxygen management program. The program will be focused on ensuring adequate DO levels for the ecosystem. Techniques to accomplish this objective may include artificial aeration of areas of Landa Lake or other solutions. If appropriate, the program may include removal of decaying vegetation. Removal techniques for decaying vegetation, if necessary, may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal. In this way, greater dissolved oxygen will remain available for the living aquatic ecology, rather than be consumed in the decay process.

5.2.5 Control of Harmful Non-Native Animal Species

To minimize and mitigate the impacts of low flows, the City of New Braunfels will conduct non-native animal species control on an annual basis. Initial control efforts will be intense and take place during the winter's first freeze, with continued control every winter. Control of non-natives will include annual maintenance and monitoring and non-natives will be disposed of out of the

floodplain. The non-native animal species that will be addressed include the suckermouth catfish, tilapia, nutria, and ramshorn snail. Potential control methods are discussed below.

Studies have shown that many fishes (especially small fish) have very similar food habitats (Hubbs *et al.* 1978). If non-native species are added to the aquatic ecosystems, greater competition or overlap among species is possible as these non-native species may be able to acquire resources with greater efficiency than native species (USFWS 1984). Suckermouth catfishes (*Loricariidae*) are a non-native fish species that has become established in the waters of Texas including the Comal River. (Howells 2005). Suckermouth catfishes prefer to feed on periphyton and algae (Hoover *et al.* 2004). The fountain darter lays eggs on algae and loss of spawning habitat and possibly egg predation are potential threats from suckermouth catfish (SSC 2009). There is some concern that excessive numbers of suckermouth catfishes could cause direct (potential displacement) and indirect effects (disruption of food supply) to the fountain darter in the Comal River (SSC 2009). Suckermouth catfishes also burrow into the river banks, destabilizing them and causing the introduction of additional sediment load into the habitat.

Tilapia is another non-native fish species that can impact fountain darter habitat. Tilapia destroys vegetation by making bare ground nests. During times of low flow and drought this could further reduce already limited habitat for the fountain darter. Tilapia is a tropical species that will congregate in winter near spring openings and other warm water sources. When tilapia congregate this creates the opportunity to use seines, gill nets, cast nets, or other methods to remove large quantities with minimal impact to the habitat. Artificial heating could be one method used to congregate fish in areas away from springs and endangered species to minimize the impacts from collection efforts.

Similarly, tilapia tend to congregate in backwater pools during summer months. This may afford another opportunity for effective removal of the fish.

A non-native gastropod (giant ramshorn snail [*Marisa cornuarietis*]) also poses a threat to the Comal Springs ecosystem. The giant ramshorn snail, a species in the aquarium trade, was first discovered in Landa Lake in 1984. (McKinney and Sharp 1995). This snail grazes on aquatic plants and in the 1990s played a major role in reducing plant biomass in Landa Lake. This snail prefers clear streams and pools with temperatures of at least 66°F (19°C). When exposed to lower temperatures, the snails withdraw into their shells and only survive for short periods. The warmest temperature that the giant ramshorn snail can withstand is 102°F (39°C). Although the population has diminished since the mid-1990s, the potential for future alteration of plant communities by the Ramshorn in the Comal ecosystems remains. (McKinney and Sharp 1995; BIO-WEST 2007c). The strong preference of fountain darters for aquatic vegetation highlights the concern posed by the grazing activities of the giant ramshorn snail (BIO-WEST 2004a). This species will be monitored closely to assure that it does not significantly reduce the available fountain darter habitat.

5.2.6 Monitoring and Reduction of Gill Parasites

A major concern in the Comal Springs ecosystem is the continued presence of an Asian trematode, *Centrocestus formosanus*. This parasite was first discovered on fountain darters in the Comal River during October 1996. The parasite attaches to the fish's gill filaments causing extensive gill tissue proliferation and damage (Mitchell *et al.* 2000) with mortality in the wild being reported following the discovery in 1996 (Tom Brandt, personal communication).

A non-native snail, *Melanoides tuberculatus*, that has been in central Texas since 1964 (Mitchell *et al.* 2005) has been confirmed as *C. formosanus*' central Texas first intermediate host (Mitchell *et al.* 2000). Parasite monitoring via examination of presence on fountain darter gills to determine *C. formosanus* levels in the Comal River has been ongoing since the late 1990s by the USFWS, Texas State University, and BIO-WEST (EAA Variable Flow Study).

In 2010, USFWS and BIO-WEST conducted a pilot study for the EARIP to determine the effectiveness of *Melanoides tuberculatus* removal on lowering drifting gill parasite numbers in the Comal River. (USFWS NFHTC and BIO-WEST 2011). The study confirmed that removing *M. tuberculatus* from the Comal River will result in a decrease in *C. formosanus cercariae* in the water column. It also recommended adaptive management studies to better determine the magnitude and duration of the benefits from snail removal.

To minimize and mitigate for the impact of low flows, the City of New Braunfels will retain and oversee the work of a contractor to establish a gill parasite monitoring and reduction program. The program may consist of non-native snail removal based on the pilot study conducted by USFWS and BIO-WEST (*Id.*). However, additional research on the most effective means of gill parasite removal will be conducted as part of the AMP as discussed in Section 6.3.6 to determine the method of gill parasite control that will actually be implemented.

5.2.7 Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries

Hazardous materials transported by vehicles across the watershed of the Comal River and its tributaries present the possibility of accidental spills or releases into the environment. The limited geographic distribution of the Covered Species at Comal Springs could cause the species to be highly impacted by such a spill. The City of New Braunfels will coordinate with the Texas Department of Transportation (TDOT) to prohibit transportation of hazardous materials on routes that cross the Comal River and its tributaries. This effort may include legislation, City of New Braunfels ordinances, additional signage, and TDOT approval.

5.2.8 Native Riparian Habitat Restoration

To minimize and mitigate the impacts of low flow, the City of New Braunfels will restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). The method of riparian zone establishment will include the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and plants with

extensive root systems will be given preference to create the maximum beetle habitat. Fine sediment covering exposed roots and springs will also be removed. The riparian zone will be monitored (at least annually) for continued success and removal of reestablished non-natives. Riparian zones will be protected until the preferred riparian zone is established. Riparian habitat zones will be created along both sides of Spring Run 3 and along the portion of the western shoreline that is owned by City of New Braunfels.

In addition, riparian restoration also benefits the system through bank stabilization and nutrient and sediment processes. The City of New Braunfels will develop a program to incentivize private landowners on the Comal River and its tributaries to establish riparian zones along the western shoreline.

5.2.9 Reduction of Non-Native Species Introduction and Live Bait Prohibition

Introducing non-native species into the Comal Springs and River results in predators and competitors for the Covered Species in the ecosystem. To mitigate the impacts of recreation and pumping from the Aquifer during drought, the City of New Braunfels will undertake measures to stop or substantially reduce the introduction of non-native species from aquarium dumps and prohibit the use of live bait species.

The City of New Braunfels will prohibit by Ordinance introductions of domestic and non-native aquatic organisms, targeting specifically bait species and aquarium trade species into the Comal system. This action will include signage at key entrance points to parks on Landa Lake and the Comal River.

5.2.10 Litter Collection and Floating Vegetation Management

To minimize and mitigate the impacts of recreation and pumping during low flow periods, the City of New Braunfels will clean litter and debris from and manage floating vegetation in the Comal Springs, Landa Lake, and Old and New Channels of the Comal River. Litter and debris collection both flood-related and routine, will utilize self-contained underwater breathing apparatus (SCUBA). Debris removal also includes the removal of litter from floating vegetation mats before dislodging the vegetation mat and allowing it to continue downstream. Vegetation mats shade out native vegetation and create die off of vegetation if the mats are allowed to collect and grow in size. By dislodging the floating vegetation mats, fountain darter habitat is maintained and protected.

5.2.11 Management of Golf Course Diversions and Operations

Historically, the City of New Braunfels Golf Course has not used its full permitted surface water rights for irrigating the Golf Course. From 2006 through 2010, an average of 115.4 ac-ft/yr of water was diverted under both permits for golf course irrigation compared to the full permitted amount of 300 ac-ft/yr. To reduce use of Comal River water further, the City of New Braunfels

is working with New Braunfels Utilities under a grant received by the Texas Water Development Board to develop and implement a reuse water system that will be used to maintain the golf course by supplementing or, to the extent feasible, replacing the surface diversions used for irrigation purposes. The design process has been started for the reuse system.

The City of New Braunfels will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the Covered Species. Any chemicals used will be applied by a licensed applicator in a manner consistent with the label directions. Expanded water quality sampling targeted at Golf Course operations will be conducted per Section of 5.7.2 of the HCP. Changes in golf course management will be addressed through the AMP as set out in Article 7 of the FMA.